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THE
LARYNGOSCOPE.

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SURGERY OF THE FACIAL NERVE IN 300 OPERATED CASES.*

THOMAS G. TICKLE, M.D.,
New York, N. Y.

This brief paper is based on my experience and the observation of some 300 cases of facial paralysis that have been operated upon from 1930 to the present.

As you all know, the old operation "to cure" facial paralysis was an anastomosis of some other nerve in the neck with the facial nerve. Drobnick, in 1879, was first credited with anastomosing the spinal accessory to the facial, but no record of this operation can be found. Sir Charles Ballance, of London, performed and reported this operation in 1895.

These cases of anastomosis — which restored some of the facial movements — always left something to be desired: The so-called emotional response was lacking and there was always the associated movement; if the spinal accessory was used, upon movement of the shoulder there was movement of the facial muscles, and vice versa; there was also an atrophy of the shoulder muscles supplied by this nerve. When the hypoglossal was used, there was movement of the face upon moving the tongue, with an atrophy of the side of the tongue.

Direct-line repair, *i.e.*, using a piece of fresh nerve taken from some other nerve in the body to bridge the gap in the facial nerve, as suggested by Ballance and Duel in 1930, elim-

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inates most of the associated movements. This piece of nerve can be either motor or sensory, preferably sensory, as this does not paralyze any muscle in the body. I use the anterior femoral cutaneous — a branch of the anterior crural.

There are two types of cases that are responsive to surgical treatment: one resulting from injury to the facial nerve and the other the socalled "Bell's palsy." The cases that develop a facial paralysis following injury to the facial nerve should be tested daily with faradic current because so long as there remains response to this faradic stimulation, these cases should be left alone (I have never seen one that did not recover most of the facial movement); on the other hand, those that lose this response to faradic stimulation should be investigated immediately, since this loss means that there are no impulses from the brain "getting through" the nerve.

It must be remembered that faradic current works through the nerve and galvanic current through the muscles; therefore, one can see why so much importance is attached to faradic stimulation. While I admit that this is not the "last word" in testing nerves, it is as yet the best criterion we have as to what is going on in the nerve; so, until something better comes along, I will continue to be guided by this reaction.

Operative Procedure: In attempting to uncover the facial nerve, I always pick it up at the stylomastoid foramen for two reasons: this is the easiest way to find it — especially if nearly all the landmarks have been destroyed at the time of the original injury — or the nerve may be lying loose in granulations. If the nerve is not already cut in two, one may do this when cleaning out the granulations and searching for it. I start by biting off the tip of the mastoid with a pair of small rongeurs until the nerve may be seen entering the stylomastoid foramen; from here, by means of small curettes and rongeurs, the nerve is uncovered up to the site of the injury, where it is inspected and the amount of injury ascertained. If a piece of nerve is missing, the proximal end is then located and uncovered for a short distance until healthy nerve is encountered; if possible, both the proximal and distal ends are freshened by cutting squarely just above and below the injured part. The sheath is then slit over the entire exposed proximal and distal ends, the dehiscence in the facial nerve is then measured and a few millimeters more than the

required length are excised from the nerve of choice. This fresh piece of nerve is snugly placed in between the cut ends of the facial nerve. Be sure that no blood clot intervenes.

Should there be much bleeding at the time the graft is inserted, this is best controlled by pressure and hot saline solution. Much has been written about using sutures to hold the graft in place: this is not only unnecessary but actually may be detrimental to the end-result; I believe it helps to form more scar tissue. The only time a suture is necessary is when the graft is in soft tissues.

Regarding the use of "glue" to fasten the ends together: I know of no better "glue" for this purpose than the bleeding that will ensue after the graft! I use a piece of gold-leaf to hold it in place, and it always keeps the packing from sticking to the graft and pulling it loose at the time of the dressings.

If after uncovering the nerve one finds only a slight injury to the sheath, a spicule or bone pushed into it, or should most of the nerve be left, a decompression of the nerve — including the slitting of the sheath — is all that is necessary. If, however, only a few strands of the nerve are left, do not cut these out but take a piece of fresh nerve and lay it along the strands, tucking it into the proximal and distal ends. Here again, a piece of gold-leaf is laid over the entire exposed nerve; otherwise, no gold-leaf is used in decompression operations.

Dressings: In cases requiring a graft following a simple mastoidectomy, the wound is left open for dressings; as soon as the graft looks healthy and is partially covered over with granulations, the gold-leaf is removed and, a few days later the wound is closed except at the lower end, where a small drain is inserted to take care of any infection that may be present. Should the grafting follow a radical mastoidectomy, the posterior wound is closed completely and the wound is dressed through the enlarged canal cut at the time of the original operation. In this case the gold-leaf is removed at any time the surgeon feels it is safe to do so, or it can be allowed to remain for months, since it does not seem to act as a foreign body.

The question arises about operating upon cases where there is an infection still present: I do not think it makes any

difference in the final outcome whether or not there is an infection present. While theoretically this seems contrary to all surgical principles, it has not proven so in the cases upon which I have operated; in the films that I will show later, considerable infection was present at the time of operation in nearly all the cases.

In the cases of so-called "Bell's palsy" I believe that surgery is often indicated. While it is true that 85 to 90 per cent of these cases recover, there are a number that do not recover — or only partially recover. I believe these cases can be helped by surgery if operated upon a short time after the onset of the paralysis. Here again, I depend upon the patient's response to faradic stimulation since all my cases who retained their response to faradic current have recovered; on the other hand, those who lose their response to faradic stimulation may never — or only partially — recover. I believe that these cases should undergo a decompression operation as soon as the response is lost, or — at any rate — within a few weeks' time.

In the early cases upon which I have operated, the results have been most gratifying; in those where the paralysis had lasted longer than six months, the results were not so satisfactory.

The operation consists of uncovering the facial nerve from the stylomastoid foramen up to the horizontal semicircular canal and slitting the sheath. It is not necessary to remove all the cells in the mastoid; only enough to permit the uncovering of the nerve. After slitting the sheath, the posterior wound is closed completely without drains. I believe it is useless to operate either in cases of injury or "Bell's palsy" where there is no response to galvanic stimulation. Absence of response indicates that the muscles have atrophied or become fibrosed and in the cases upon which I have operated the results have not been successful.

Return of Function: In the cases where a decompression of the nerve only is necessary, function will usually return in two or three months' time; in the cases where a nerve graft is necessary, the return of function will not be noticeable until after an interval of from six to nine months. Many weeks before voluntary motion is observed, the face will

appear to be straighter in repose and the patient will report that all his friends notice this change. This is due to the returning tonus of the muscles. The first actual voluntary motion will be observed at the corner of the mouth and this only upon the forced closure of the eyes. (Ask the patient to forcibly open and close both eyes, then watch the corner of the mouth.)

The return of motion will always be gradual in the other muscles except in the case of the frontalis, where function will practically never return. The patient will always have trouble in raising the corner of the mouth and, because there will always be a slight associated movement, the best results will never be perfect. This associated movement is believed to be due to a splitting of the neurons: when the nerve regenerates, the neurons do not always follow their former course but may stray from one nerve-bundle to another; thus the fibres destined for the upper branches of the facial nerve may find their way into the lower, and vice versa. There is usually a slight tic-like motion present upon the return of function. Why? I do not know.

After-Treatment: I think the patients should have some form of massage of the facial muscles because this helps to keep the muscle from atrophying until the function of the nerve returns. I prefer galvanic massage: Not only does it tone up the muscles but it has a stimulating effect upon the patient's morale. I also think some form of support is beneficial to brace up the sagging muscles of the face. I use a "hook" fastened to a headband to insert at the corner of the mouth. This should be removed at will, for if worn too long it will irritate the corner of the mouth. Re-education is also a very important factor in the final outcome. The patient himself can accomplish much if he sits before a mirror diligently practicing such expressions as laughing, talking, smiling, in order to make the movements as nearly symmetrical as possible.

30 East 40th Street.

SURGICAL TREATMENT OF CANCER OF THE LARYNX.*

CHEVALIER L. JACKSON, M.D., and CHARLES M. NORRIS, M.D.,
Philadelphia, Pa.

The treatment of cancer of the intrinsic larynx is by *surgery* or by some form of *irradiation*, or by a combination of these methods.[1] In the surgical treatment, the choice lies between *total laryngectomy* and some form of *partial laryngectomy*. The most commonly used form of partial laryngectomy is that known as *thyrotomy* or *laryngofissure*, in which access is had to the growth by a splitting of the thyroid cartilage, after which the growth is removed, along with a margin of normal tissue. Another form of partial laryngectomy is *hemilaryngectomy*, an operation which has given good results in the hands of some operators, particularly Hautant in France, but has never been accepted in this country. Occasionally *epiglottidectomy* is justifiable, in the case of tumors limited strictly to the epiglottis. *Endoscopic resection* under suspension laryngoscopy has been successfully accomplished, but certainly this technique is suitable only to very early and limited cordal lesions.

Total laryngectomy may be done by various techniques, and some of them differ so much as to constitute really different operations. If the entire epiglottis and the entire cricoid are not removed, as they need not necessarily be in every case, perhaps we should call the operation *"subtotal."* On the other hand, some operators always remove the hyoid bone and pre-epiglottic space, which makes the operation something more than a total laryngectomy. In the case of extrinsic lesions, with involvement of adjacent structures, as, for example, the pharynx or the base of the tongue, obviously an attempt at surgical extirpation will require more than total laryngectomy. In such cases, few feel favorable to surgical treatment, but those who do generally use a technique of *laryngopharyngectomy* such as that described by Orton.[2]

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Treatment by irradiation may mean the use of *Roentgen rays*, which are now generally administered by some form of "protracted fractional" (Coutard) technique; or the use of some form of *radium*, as, for example, the *"saturation technique,"* with radium packs applied to the neck externally. In certain cases *radon* (gold "seeds" containing radium emanations) or removable radium needles are inserted. One of the forms of combined surgery and irradiation was the technique of application of radium through a laryngostomy opening formerly used by Martin[3] and still used by him and others in certain cases. Another form of combined surgery and irradiation is the neck dissection and radon implantation used in the treatment of cervical metastasis.

The methods of treatment of cancer of the larynx which the authors use routinely are *laryngofissure* by either the "clipping" or the "anterior commissure" technique, *laryngectomy*, and *irradiation by Roentgen rays*. The criteria for the selection of a method of treatment were described in a recent paper written in collaboration with Dr. John V. Blady,[4] but the indications for surgical treatment as we see them may be summarized as follows: *1*. Lesions occupying the middle third of one vocal cord are suitable for laryngofissure by the "clipping" technique. *2*. Lesions reaching the anterior commissure and even involving the opposite cord are also amenable to extirpation by the laryngofissure route, but in such cases the "anterior commissure" technique should be used. *3*. Lesions in which the growth is cordal but has reached the posterior end of the cord and produced impairment of motility, or has extended subglottically, ordinarily call for total laryngectomy, as do lesions involving the ventricles or ventricular bands. *4*. Lesions in which tumor has invaded cartilage (but not muscles) also call for laryngectomy, providing there are no metastases. In some cases in which there are metastases, combined laryngectomy and neck dissection may be done.

Irradiation is preferred in the case of lesions unsuitable for laryngofissure, in which laryngectomy is contraindicated by the age, physical condition or temperament of the patient. It is also generally used for growths "inoperable" because extrinsic by origin or extension, or because of cervical metastases. The latter cases must be treated by *protracted irradia-*

tion, followed immediately by implantation or radon, either through the skin, or better, after surgical exposure. Cervical metastasis developing after operation, without local recurrence, should be treated by neck dissection and radon implantation, not necessarily preceded by the deep Roentgen therapy. Lesions which have reached the posterior extremity of the cord but have not produced impairment of motility of the cord constitute a group for which laryngofissure is contraindicated but for which irradiation may be preferred to laryngectomy.

LARYNGOFISSURE.

The technique of laryngofissure used by the authors at the Temple University Clinic at the present time is as follows:

Step 1. Anesthesia. Local anesthesia by infiltration with novocaine 1 per cent intradermally and then subcutaneously along the midline of the neck. The local anesthesia is completed by topical application of cocaine 10 per cent (or pontocaine 2 per cent) to the interior of the larynx and upper trachea on a swab introduced through an incision in the cricothyroid membrane after the operation is under way. This application is analgesic and eliminates the cough reflex from the larynx and upper trachea; also, it produces slight ischemia of the mucous membrane and soft tissue of the interior of the larynx, lessening the amount of oozing from cut mucous membrane and muscles. The cough reflex from the lower trachea and bronchi, however, is preserved. General anesthesia, while entirely unobjectionable for total laryngectomy, is, in the authors' opinion, contraindicated for laryngofissure, because it greatly increases the operative risk, both from hemorrhage and from pulmonary complications.

Step 2. The Incision. A straight vertical midline incision from the thyroid notch to just below the level of the cricoid is used. If tracheotomy is to be done, the incision may be prolonged downward to the suprasternal notch, but we do not do tracheotomy as a part of the standard operation. Chevalier Jackson has emphasized the importance of *not skeletonizing the larynx in laryngofissure,* because of the unnecessary trauma thus inflicted on the external perichondrium and consequent impairment of nutrition of the thyroid alae.

Step 3. Special Cover. As soon as the incision has been made, the thyroid and cricoid cartilages exposed, and hemostasis accomplished, a special cover consisting of a sheet with a slit in it to fit the wound is put in place, the edges of the opening being clipped to the skin margins.

Step 4. Incision of Cricothyroid Membrane. After placement of the special cover, the cricothyroid membrane is incised either transversely or vertically, and topical application of cocaine made to the interior of the larynx. At first a few drops are squeezed out by pressure of the sponge against the borders of the incision, and then the sponge itself is gently introduced. Several successive applications are made in the same way.

Step 5. Division of the Thyroid Cartilage. When the lesion does not reach the anterior commissure, the "clipping" technique is used, dividing the thyroid cartilage exactly in the midline with the turbinotome; but in cases where the lesion does reach the anterior commissure, the special technique for such cases, first described in 1922 by Chevalier Jackson,[5] is preferable. The essential feature of this technique is division of the thyroid cartilage from the outside by means of an electrically driven circular saw, or in the case of patients with a very soft cartilage, a knife, this incision not going clear through the internal perichondrium. In this way one avoids cutting through the tumor. In a recent series of 50 cases,[6] the clipping technique was used in 32 and the Jackson "anterior commissure" technique in eighteen.

Apropos of anterior commissure lesions, mention should be made of an interesting study by Broyles,[7] in which the "anterior commissure tendon" is described. This "tendon" constitutes the attachment of the true vocal cords to the thyroid cartilage anteriorly, and because of its structure, Broyles advises the removal of a portion of each thyroid ala along with the anterior portion of the cords in the anterior commissure cases. This procedure has also been advised by Clerf.[8]

Step 6. Inspection of Interior of the Larynx. If the patient has been properly studied beforehand by direct as well as indirect laryngoscopy, one should have a fairly accurate idea of the location and extent of the lesion; but after the larynx is opened it should again be carefully examined before the

excision is begun. In the *clipping operation* this is simple, but in the *anterior commissure operation* it is a little more difficult. In the former, we can inspect the lesion before doing even the subperichondrial dissection, but in the anterior commissure operation it is necessary first to separate the internal perichondrium on both sides and then to section vertically *the less involved cord and ventricle* so that it can be reflected in such a way as to permit good visualization of the entire interior of the larynx. This careful inspection permits one to decide upon the extent of excision necessary to give a safe margin of normal tissue around the growth.

Step 7. Partial Removal of Cartilage. We do not resect the cartilage, but some operators think it desirable to do this.

Step 8. Excision of the Growth. After subperichondrial dissection, the tumor-bearing mass, including generally the tip of the vocal process of the arytenoid on the more involved side, is excised with special curved scissors. If possible, the mass excised is kept in one piece, but of course it may be necessary to remove additional tissue if it is found that the margin is insufficient on either side. To take a full centimeter of normal tissue on all sides according to the "centimeter rule" of Chevalier Jackson is ideal but not always practicable.

Step 9. Hemostasis. Plain or iodoform gauze is tucked into the open larynx immediately after the excision, while the operative specimen is inspected, and generally most of the bleeding will stop with this alone. If a spurting vessel can be caught quickly with a hemostat, so much the better, because later it may retract and be difficult to find. The larynx must be absolutely dry before closing, or postoperative bleeding will be sure to occur. Occasionally one or more suture ligatures of fine catgut are used in the interior of the larynx, particularly in the region of the arytenoid cartilage. If the excision has included one or both ventricular bands, the base of the epiglottis will be left without support and should be stitched forward as suggested by Gabriel Tucker.[9] This will tend to prevent stenosis anteriorly.

Step 10. Closure. No sutures are put through the perichondrium or cartilage, though a suture or two may be used in closing the incision in the cricothyroid membrane. The fascia and muscle are closed with buried sutures (alloy steel

wire) and the skin with Michel clamps. We have used no drainage for the past several years, though formerly a small wick of iodoform gauze was left in the lower end of the wound. The older practice of leaving the wound open and packing down to the cartilage has been entirely abandoned.

Step 11. Dressing. A plain gauze dressing is applied. The dressings are changed daily and the clips removed on the third or fourth day.

After-Care. The patient is kept sitting up, or rather with the head of the bed elevated. He is instructed not to talk, but to use a pad and pencil to express himself. After a few hours he is given liquids and soft solids, being encouraged to sit up, lean slightly forward and take a good swallow rather than sipping or taking the liquids through a glass tube. In very few of our cases has a feeding tube been used, but if an extensive excision is made, and especially if a large portion of the arytenoid is removed, it may be necessary to insert one. Opiates are contraindicated, and only the very mildest sedation is permissible. The wound is generally healed externally in four or five days, but the healing of the interior takes several weeks. Most patients are discharged from the hospital in from one week to 10 days.

Complications. Hemorrhage, if it occurs, almost always occurs within the first 12 hours. It was observed in only two cases in our recent series of 50.[6] It may be necessary in such cases to pack the larynx temporarily, but generally the bleeding point can be found and the vessel ligated. Obviously, it is necessary to insert a tracheal cannula if packing is done.

Granulomas form in about 35 per cent of the cases. Generally they shrink and disappear within a few weeks. They should be given a chance to do that, and if they do not they should be removed by direct laryngoscopy, because their presence, even though not obstructive to an important degree, will interfere with the development of voice.

Abscess, perichondritis and chondral necrosis occur in a certain percentage of cases. Often the extrusion of á little sequestrum of cartilage or bone will be followed by prompt healing, but in some cases a number of pieces come away before the wound will heal. This complication should be treated conservatively.

Bronchopneumonia occurred in only one case of the above-mentioned series, though pulmonary complications (*pneumonia, atelectasis, pulmonary abscess*) were formerly rather frequent and often fatal in patients who had undergone laryngofissure. The use of a local anesthesia and the withholding of postoperative opiates are probably the chief factors in the lowered incidence of pulmonary complications.

LARYNGECTOMY.

Preparation. Proper attention to preoperative study and treatment will have a profound effect on operative morbidity and mortality. Thorough physical examination, supplemented by Roentgen-ray examination of the chest, serologic study, blood count and urinalysis, and blood chemistry determination are indicated. Other conditions found may not change the course of treatment necessary for the cancer of the larynx, but they often call for certain preliminary treatment. Oral sepsis must be eradicated, even if it takes two weeks or longer to do so. If there is sugar in the urine or the blood sugar is above normal, an effort should be made to correct or improve this condition before operation. Diabetes certainly increases very much the risk of postoperative complications, and the medical care of patients having this disease before and after operation may prevent prolonged convalescence or even postoperative death.

The steps in laryngectomy as we are now doing it are as follows:

Step 1. Anesthesia. Infiltration of the skin and tissues of the neck with novocaine 1 per cent, with a basal anesthesia of avertin per rectum supplemented by intravenous sodium penthotal. Martin, New,[10] Cunning[11] and others prefer to use local only. If there is any respiratory obstruction, a rubber nasal airway should be inserted; or, if the obstruction is glottic or subglottic, an intratracheal catheter or a bronchoscope may be used.

Step 2. Incision. A midline incision is made from the hyoid bone to the suprasternal notch. The incision should not be continued downward below where it is desired to locate the stoma, as this causes an unnecessary downward extension of the scar. If desired, the vertical incision can be made still

shorter, and a circular "buttonhole" opening made for the tracheal stoma, leaving a narrow band of skin between the lower extremity of the vertical incision and the circular one. This technique is particularly desirable in cases where there may be sloughing, as in patients who have had extensive irradiation (see Fig. 1).

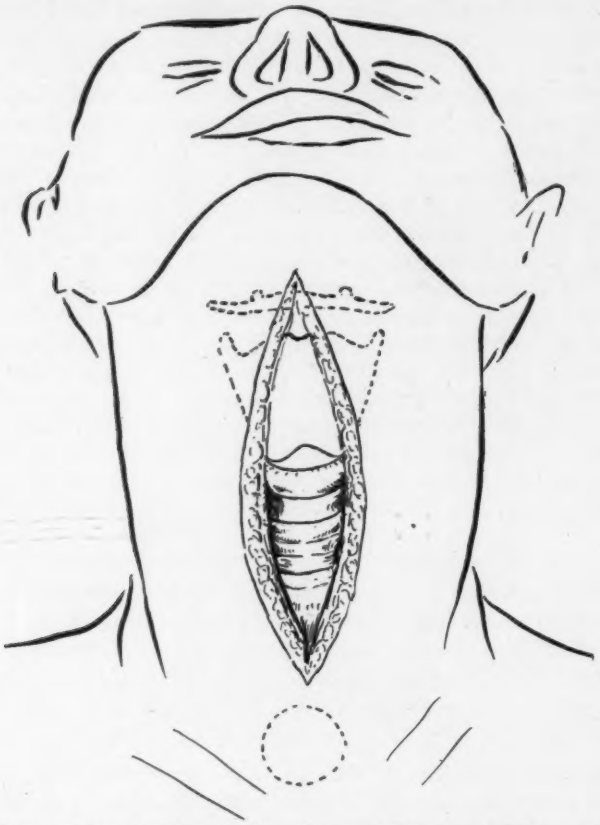

Fig. 1. Vertical incision used for "narrow field" laryngectomy. Dotted line shows optional separate circular incision for tracheal stoma.

Step 3. Division of Thyroid Isthmus. As soon as the skin and fascia are incised, the thyroid isthmus is exposed just below the cricoid cartilage and divided between Kelly clamps. The cut ends are sutured with chromic catgut and the clamps

removed. This procedure exposes the anterior surface of the trachea and makes it possible to let air in at any moment if respiratory obstruction develops.

Step 4. Skeletonization of the Larynx. The sternohyoid muscles, as well as the sternothyroids and thyrohyoids, are separated in the midline, and the insertions of the latter two into the thyroid cartilage separated from the thyroid cartilage by subperichondrial dissection so that, if possible, their continuity with each other is preserved. The inferior constrictor muscles of the pharynx are then divided along the posterior edges of the thyroid alae, and the other muscular attachments severed, the inferior laryngeal vessels being ligated as they are reached. This skeletonization is carried out first on one side and then on the other, or the surgeon may do one side and have an assistant do the other at the same time, as suggested by de Sanson. Crowe and Broyles[12] have described a technique according to which the entire skeletonization is done subperichondrially. This might be considered an extreme form of the "narrow field" (Jackson[13]) or "close dissection" (Gatewood) technique. These names describe the current general trend toward a more conservative technique of operating for the extirpation of the larynx in cases of intrinsic cancer, rather than any one individual's personal technique. Experience has shown that the anatomical basis for the use of the "narrow field" type of operation in such cases is sound. At this point it should be stated, however, that in cases where the lesion has extended through the thyroid cartilage, obviously the overlying muscle should be left attached to the larynx and removed along with it, or removed first. Hayes Martin prefers always to remove the inner ribbon muscles (sternothyroid and thyrohyoid) with the larynx, but leaves the sternohyoid muscles intact for overlapping in closure.

Step 5. Division or Resection of the Hyoid Bone. The larynx can be removed without disturbing the hyoid bone, but most operators feel that division (New) or resection (Orton, Cunning, Clerf) is of advantage. Facilitation of pharynx closure is the reason most often given for this procedure, but another good reason for partial or complete resection is that if this is done complete removal of the preepiglottic space (see Fig. 2) is more easily accomplished

(Bisi[14]) and this is important, especially in cases in which the lesion involves the ventricles or ventricular bands, because it has been shown by serial sections (Leroux-Robert[13]) that such lesions readily extend to this space. It is the authors' practice, in most cases, to resect the central portion of the body of the hyoid bone, but they believe that the

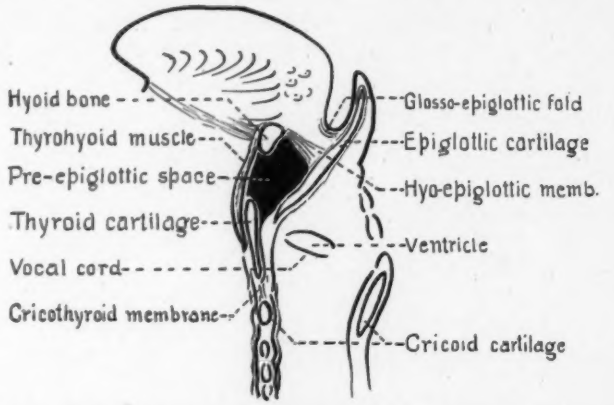

Fig. 2. Diagram showing location and extent of pre-epiglottic space, a region very important because often the seat of extension of carcinoma involving the ventricles of the anterior portion of the ventricular bands. Its clinical importance has been emphasized by Bisi[14]

removal of the entire bone is useless, necessitating the detachment of many muscles from their insertions into it. Martin prefers to leave the hyoid bone undisturbed.

Step 6. Amputation of the Trachea. The trachea is divided just below its first ring and stitched forward with one temporary suture to the skin. An inner cannula wrapped with vaseline gauze is inserted into the trachea to prevent blood from running down into it, as the separation of the posterior surface of the larynx from the esophagus and pharynx is carried upward.

Step 7. Cutting of Cornua and Ligation of Superior Laryngeal Arteries. As the larynx is lifted upward and the superior cornua of the thyroid cartilage are reached, they are amputated or dissected free. If they are to be amputated and left *in situ* care must be taken not to denude them of perichondrium. If they are dissected free, it must be borne in mind that their tips are just submucosal, and precautions

taken not to produce a perforation. Immediately after amputating the cornua, or dissecting them free, the superior laryngeal vessels should be ligated. They are ordinarily seen entering the thyrohyoid membrane just a little above the edge of the thyroid cartilage and a little anterior to the cornua.

Step 8. Opening of the Pharynx and Removal of the Larynx. The pharynx can now be opened in the midline pos-

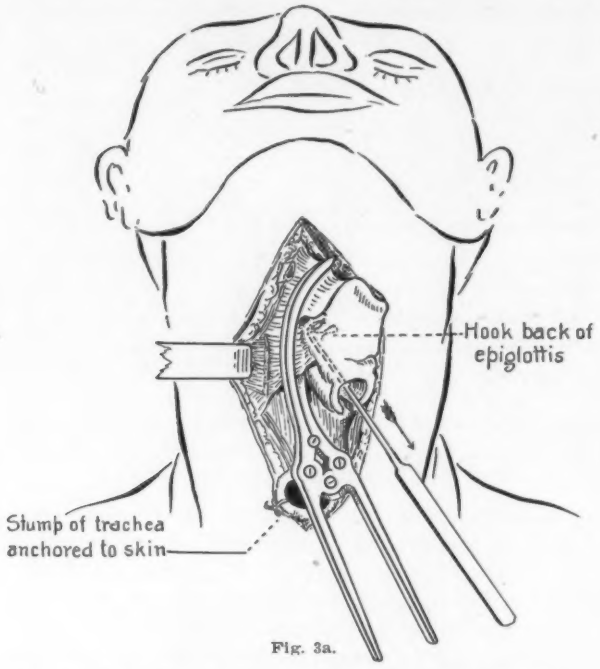

Fig. 3a.

Figs. 3a and 3b. Sketches showing the use of the Brazilian (Vasconcelos-Barretto[16]) clamp in "aseptic" laryngectomy.

teriorly, just above the arytenoids and posterior commissure, the incision being continued around both sides to the valleculae, taking care to conserve as much mucous membrane as possible; however, the innovation in technique suggested by two Brazilian surgeons (Vasconcelos and Barretto[16]) greatly facilitates this part of the operation. This consists of the

application of a special clamp to the pharynx before it is opened, then dividing the pharynx with one simple stroke of the knife, along the upper concave surface of the clamp (see

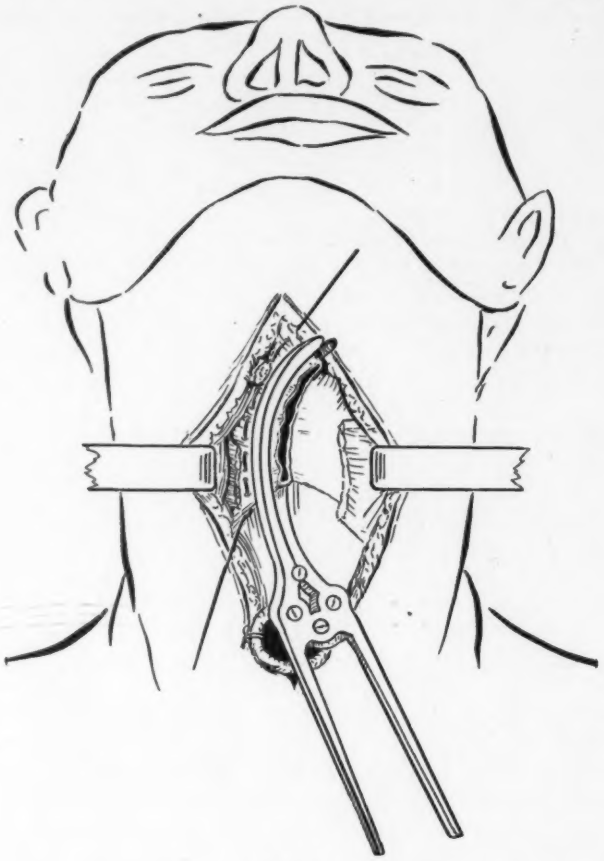

Fig. 3b.

Figs. 3a and 3b). This prevents contamination of the wound with pharyngeal contents and simplifies suture of the pharynx. In order not to include a portion of the epiglottis in the clamp, it is necessary to pull the epiglottis down into the supraglottic larynx with a hook or a Kelly clamp. The authors

have found that this maneuver is more easily accomplished if the larynx is split through the posterior commissure with shears.

Step 9. Closure of the Pharynx. If the Brazilian clamp is used, first a temporary suture of black silk is inserted, and then, after removal of the clamp, a continuous inverting suture of No. 00 chromic catgut. The edges of tissue which have been compressed by the clamp are thus inverted.

If the clamp is not used, it is necessary to locate and close the upper extremity of the pharyngeal wound with great care and then to complete the closure in the form of a "U," a "Y" or simply a vertical line. Chromic catgut (No. 00) interrupted sutures are used, and at least every other one, if not all, should be submucosal. If preferred, of course, continuous sutures may be used. The first line of sutures is reinforced by two more, which include the remaining portions of the pharyngeal constrictor muscles and the perichondrium if dissection has been subperichondrial.

Step 10. Closure of the Muscles. The sternohyoid muscles, which have been preserved intact, and also the sternothyroid-thyrohyoid muscles, if they have been preserved, are brought together and overlapped in the midline. This gives firm support to the pharyngeal suture line. Additional support is given by a "corset" (Tapia) of perichondrium, if subperichondrial dissection has been done. (see Fig. 4).

Step 11. Drainage. Elaborate drainage and even irrigation was formerly the routine procedure in laryngectomy, but the improvements in technique of recent years have made such methods obsolete. The authors have used for some time a simple technique of drainage by one small (Babcock[17]) elbow sump tube of glass or alloy steel, inserted under the muscles, into which is passed a catheter connected to a little ("flea power") electric pump (see Fig. 4). Thus gentle negative pressure is applied for the first 36 to 48 hours, after which the sump is generally removed. By this means a considerable quantity of serosanguineous fluid is drained off, and not only is wound tension reduced, but substance which would make good culture medium for wound infection is eliminated. As

a matter of fact, some surgeons are dispensing with all drainage and reporting good results.

Step 12. Closure of Skin. The skin margins are approximated to the mucosal edges of the tracheal stump and to each other in the vertical part of the incision, with alloy steel

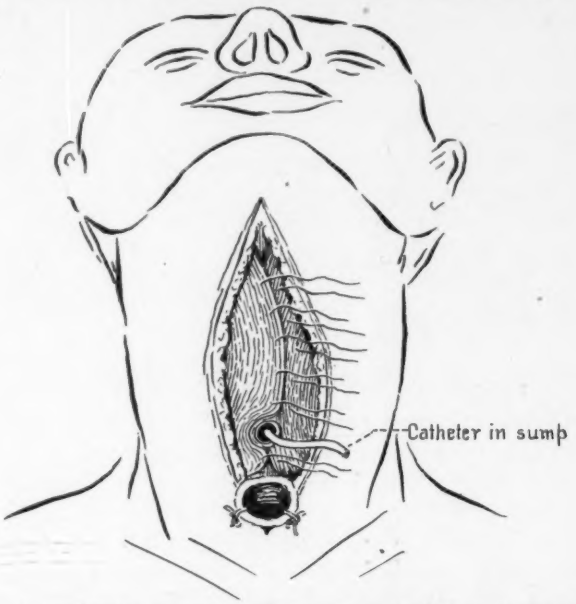

Fig. 4. Overlapping of muscles for support of pharynx in "narrow field" laryngectomy. This sketch also shows use of small glass or alloy steel elbow sump tube for drainage (Babcock).

wire; or Michel clamps may be used for the latter if desired. It is desirable to obtain an immediate union of the skin between the stoma and the drainage tube, if no band of intact skin has been left. Of course, if a circular "buttonhole" incision has been used for the trachea, in combination with either a vertical or a transverse incision, the stoma may be completed before the larynx is removed.

Step 13. Dressing. The incision is covered with a strip of boric ointment gauze, split in its lower portion to encircle the sump drain and the cannula. External to this, several 4-by-4-inch gauze pads, split vertically, are applied from below upward and from above downward, beneath the neck

plate of the cannula and surrounding the catheter, which has been inserted into the sump drain. The dressing is secured by strips of waterproof adhesive and 2-inch bandage. A No. 14 Fr. or No. 16 Fr. Levin feeding tube is passed through the nose or, if preferred, a shorter tube (catheter) may be used.

Postoperative Care. On return from the operating room, the patient is placed in a warm bed with the back rest raised to about 30°. Room temperature is maintained at 70° F. and relative humidity should not be allowed to fall below 60 per cent. A double layer of moistened gauze laid over the cannula further assists in humidifying the inspired air. The tracheobronchial secretions are aspirated by means of a No. 14 Fr. rubber catheter introduced well below the end of the tracheal cannula. Aspiration is repeated every hour, or oftener if necessary, depending upon the amount and character of the secretion; and the inner cannula is removed and cleaned frequently by drawing through it, on a soft wire loop, a strip of moist 2-inch gauze bandage. Aeration of the lower lobes of the lungs should be checked occasionally by auscultation.

Sedatives are usually not required; if needed, the coal-tar analgesics, given by feeding tube, are preferred to opiates. Atropine should likewise be avoided, because of its drying effect on the tracheobronchial secretions.

Continuous suction is maintained through the small rubber catheter which has been inserted into the sump drain; if this should become obstructed, it can be removed and another sterile catheter inserted, although this is rarely necessary. Glucose water, 5 per cent, may be given by nasal feeding tube in amounts of from 3 to 5 oz. every two hours, beginning about six hours after operation unless there is nausea. Tube feedings of strained fruit juice, milk or eggnog may be started on the first postoperative day and increased gradually to provide adequate and well-balanced caloric intake. Additional amounts of cevitamic acid should be included in the feeding schedule. Perborate mouth wash should be used several times daily.

The dressing is changed daily, inserting a sterile tracheal cannula. The entire sump drain is usually removed on the second postoperative day. Sutures or Michel clamps may be removed from the vertical portion of the incision on the

third, fourth and fifth day; the sutures about the tracheal stoma should be left in place for a few days longer. Most patients are allowed out of bed on the third or fourth day. The feeding tube may be removed as soon as the temperature has been normal for 48 hours, following a preliminary test period of swallowing sterile water in small sips alongside the tube, providing there is no evidence of wound infection or salivary leakage. Only liquids are given for the first few days after removal of the tube, and those should be taken slowly; thereafter, pureed vegetables and other soft foods may be added to the diet, which is gradually amplified to include all kinds of solid foods.

Complications of Laryngectomy. Sepsis is unquestionably the most common complication of laryngectomy, but it is much less common if proper attention is given to preoperative studies and treatment. No patient with high blood sugar should be operated upon until every effort has been made to correct the diabetic tendency and to accomplish a maximum control, as already stated. Furthermore, oral sepsis, especially in the form of carious or abscessed teeth, should be eliminated before operation. The current use of the sulfa drugs and penicillin both preoperatively and postoperatively will doubtless also lower the incidence of sepsis, curtail its duration and lessen its severity when it does occur. In the presence of sepsis, it is necessary to see that adequate drainage is provided, in addition to administering whatever chemotherapeutic treatment may be decided upon. Incidentally, it must be remembered that irradiation lessens the vitality of tissues and greatly increases the danger of sloughing and suppuration.

Hemorrhage should be a very rare postoperative complication in laryngectomy, but if it does occur, the wound should generally be laid open and both pressure and sutures used to control it. One of the commonest predisposing causes of hemorrhage is sloughing associated with suppuration. Friable sloughing tissues are, of course, difficult to ligate or suture. One primary indication, in the presence of hemorrhage, is to prevent blood from passing down into the tracheal stoma; if blood does get down, aspiration and the removal of clots by means of a catheter or a bronchoscope is indicated.

Pharyngeal fistula is a not uncommon complication of laryngectomy, but formerly it was much more common. The type of operation herein described, with good overlapping of muscles and good conservation of blood supply, greatly reduces the tendency of this complication.

Crusting (tracheitis sicca). Some patients have a great deal of trouble with crusting tracheal secretions, and the crusts may become dangerously obstructive. They should be softened by instillation of saline or gomenol and then removed with the aspirator or, if necessary, with forceps. Prophylactically, the humidification of the air in the room and the wearing of a moist pad over the tracheal stoma will help to prevent the formation of crusts.

Pulmonary complications of laryngectomy are rare. True pneumonia is very rare indeed, though bronchopneumonia and atelectasis may occur. These conditions, when they do occur, should be treated medically and by aspiration. Certainly the chest of the patient who has had a laryngectomy should be checked daily by the methods of physical diagnosis, and if there is any question of a pulmonary complication, Roentgen-ray examination should be done. The limitation of sedatives and particularly opiates, as well as drugs which dry the secretions, such as atropine, will reduce the incidence of pulmonary complications.

Hiccough occasionally occurs as an annoying but not serious complication. There is no one effective treatment, but sometimes the removal of the long feeding tube and the substitution of a short catheter will stop it. In other cases psychotherapy seems to be effective.

Toxic delirium is sometimes mentioned as a complication in elderly patients. It is not a common one and is rarely serious.

RESULTS.

Of course, *without treatment,* cancer of the larynx is 100 per cent fatal; but the prognosis of the *treated* cases is better than in cancer of most other parts of the body. Let us consider first *operative mortality.* The cases treated surgically should be divided into those treated by laryngofissure (or "partial laryngectomy"), and those treated by total laryngectomy. The mortality of the form of laryngofissure

used by the authors should be practically zero. Of course, it cannot be said that any operative procedure is entirely free from risk, but it can be affirmed that in our clinic not a single patient has died of this operation during a period of 14 years; and during this time 148 laryngofissures have been done. According to the literature, the mortality of total laryngectomy is certainly much higher than that of laryngofissure. There have been some operative deaths even in the experience of our own clinic, but there has not been a single operative fatality in the last 70 laryngectomies. Operative mortality in laryngectomy can certainly be reduced to a very low figure if certain precautions are observed.

There are those who insist upon the unique importance of the *end-results* in the entire series of patients seen at a given clinic, as compared with the results obtained in any selected series. It is our contention that while the figures for the whole series of patients do possess a certain interest as vital statistics, the figures upon which our progress in the solution of the problems of selection and technique of treatment will be based will be those obtained from the analysis of selected groups of cases, providing the basis for selection is clearly stated. Let no one condemn the pioneer advocates of laryngofissure such as Butlin, Semon and St. Clair Thomson in Great Britain, and Chevalier Jackson in the United States, if they spoke enthusiastically of the results they obtained in the cure of early intrinsic cordal cancer by this comparatively minor operation! They never claimed to cure cancer of the larynx in 85 to 90 per cent of the cases without clearly stating that the method had its clear-cut indications and that it should be used only in those cases. The crusade for early diagnosis which they launched was fully justified by the fact that patients who could be cured by laryngofissure, if operated upon early enough, would require laryngectomy or some other radical treatment and have a poorer chance for cure if diagnosed six months later. Furthermore, it is freely admitted that in many cases the tumor springs from a part of the larynx other than the true cords, and no one has claimed that these cases could be cured by laryngofissure.

A recent analysis of the end-results in a series of 150 patients with cancer of the larynx treated at the Temple University Hospital by surgery and irradiation, during the period

from 1930 to 1937, inclusive, showed a combined five-year cure rate of 64 per cent. In 59 determinate cases in which laryngofissure was done, an 80 per cent five-year cure rate was obtained, while in 48 cases in which laryngectomy was done for an intrinsic lesion, 69 per cent obtained five-year cures. We may say, therefore, that of the 101 patients with *intrinsic lesions* who received surgical treatment by either laryngofissure or laryngectomy, 80 patients, or about 75 per cent, obtained at least a five-year cure. Nine patients with *extrinsic lesions*, upon whom laryngectomy was done, died. During the same period, 34 patients were treated by irradiation (protracted fractional technique), 22 of them intrinsic and 12 extrinsic; and in the *intrinsic* group a 59 per cent five-year cure rate was obtained, in the *extrinsic* group a 25 per cent five-year cure rate. Again let it be repeated that *the most significant and helpful figures are those obtained in clearly defined selected groups of cases by definitely stated and adequately explained methods of treatment.*

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THE USE OF OTOSMOSAN IN OTOLOGY. A CLINICAL REPORT.*†

SAMUEL J. KOPETZKY, M.D.,
New York, N. Y.

INTRODUCTION.

Otosmosan is the trade name for a pharmaceutical preparation. Its exact chemical structure is not yet entirely clarified. It consists, approximately, of a combination of urea and sulfathiazole, 10.82 per cent of the former, and 9.68 per cent of the sulfa compound. It is less a mixture than a chemical combination of the two principal components. Its specific gravity is 1.3025, and gives a refraction index of 1.5009. It does not contain a trace of water. The combination of sulfathiazole carbamide together with 1 per cent benzocaine is dissolved in a solution of absolute glycerine.[1]

In order to comprehend better the interaction of urea and sulfathiazole, a brief outline of pertinent investigations are presented:

PERTINENT REPORTS FROM EXISTING LITERATURE.

There are numerous reports on the use of urea in the treatment of wounds and infections, some of which follow. Chiariello[2] reported on the use of urea in infected wounds, particularly when secondarily infected. His results based upon experimental data were good. Olsen and his co-workers[3] studied the effects of urea incorporated in a sulfonamide base on wounds without secondary infections. They noted an increase in granulation growth but a retardation of epithelization. The urea acted like a peptonizing agent. It dissolved the debris of contaminated wounds. Baker[4] after reviewing the literature concluded that less than 5 per cent of urea possessed no bacteriostatic action, that great concentrations of between 25 per cent to 30 per cent, however, abetted heal-

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*From the Department of Otolaryngology, New York Polyclinic Medical School and Hospital.

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ing indirectly by removing necrotic tissue and drying wound secretions, thus enhancing healing and repair. In another study, Arey[5] observed that two factors play a part in the healing of a wound. These are the restoration of epithelium and the closure of the wound. The value of urea in promoting healing is furthermore noted by Robinson[6] and Kaplan.[7]

Whatever may have been recorded of the bacteriostatic properties of urea, it possesses another important effect: its hydroscopic and osmotic property.

In the treatment of infections of suppurative middle ear infections, Foulger and Foshey[8] used urea, while Mertens[9] tried it in the healing of surgical wound cavities of mastoidectomies. He lauded its mild antibacterial and wound cleansing properties.

The greatest asset of urea seems to be its capacity to influence the permeability of the cell membranes, combined with its power of liquefying and hydrating proteins.

BACTERIOSTATIC ACTION OF UREA.

Ramsden,[10] in 1902, discovered that bacteria grown in a medium containing urea exhibited pleomorphism as a consequence of the action of urea. This was confirmed by Peju,[11] who found that numbers and varieties of micro-organisms were susceptible to the action of urea. Wilson[12] gave a report which demonstrated that pathogenic types of bacteria grew in solutions with concentrations of from 1.5 per cent to 3.5 per cent of urea; however, media containing urea in concentration of 8 per cent remained sterile. These reports are substantiated by those of Symmers and Kirk,[13] MacKay and Schroeder.[14]

UREA AND SULFONAMIDES COMBINED.

In 1908, Gelmo[15] started a development which has had a great effect upon our present-day medical therapy for infections. This development consisted in the synthesis of sulfonamides and p-aminobenzene sulfamic acid.

Some note needs to be made of the mechanism of the sulfa drugs to comprehend in a general way their particular action when combined with urea. Urea generally tends to make the action of the sulfonamides more potent.

When bacteria is destroyed and there happens to be debris present in the wound tissue, the action of sulfa drugs is markedly inhibited. The destroyed bacteria and the tissue debris makes for the presence of peptones in the infected area. These peptones inhibit the activity of the sulfa drugs (Lockwood and co-workers[16]). MacLeod[17] holds the drugs and peptones as opposing factors, an observation corroborated by Stamp,[18] Woods,[19] Fildes.[20] Finally, Selbie[21] proved that p-aminobenzoic acid is the active inhibiting agent. This has been confirmed by many other investigators (Strauss,[22] Spink and Jermsta[23]). From all these reports it is evident that sulfonamides exert only an indirect bacteriostatic action. This action is nevertheless sufficient to enable the organization to fend off infectious microbes, and overcome them by mobilization of antibodies. The detailed chemistry of the inhibiting action of p-aminobenzoic acid, and the changes in its molecular structure upon the addition to it of various substances is beyond the scope of this paper.

There are records of quantitative relationship between various "sulfa" bacteriostasis in vitro. Sulfathiazole has been found the most resistant toward this particular inhibitory action of p-aminobenzoic acid.

In considering the product under consideration in this clinical study is a review of the action of urea, as an anti-inhibitor when combined with sulfa compounds.

A relatively simple chemical structure was discovered which when combined with urea neutralized the inhibitory effect of p-aminobenzoic acid. This was azochloramide. Thus Olson (et al.)[24] demonstrated the superiority of a combination of 4 per cent urea in a sulfonamide base. This compound retarded epithelization, shortened the rate but increased the extent of the formation of granulation tissue. Holder and McKay[25] confirmed the findings of Sober[26] that urea enhances the solubility of sulfonamides.

It has been found that 10 per cent urea and 5 per cent sulfathiazole appears as the best and most promising combination in the treatment of infected wounds.

The rate of absorption of sulfonamides has had extensive study. The rate of absorption differs. It is dependent upon the exact chemical structure of the drug, the condition of

the surface from which absorption is to take place, and finally the menstruum in which the drug is carried to the body tissues. Many substances have had both pharmaceutical and clinical investigation and trial. It would take me too far afield to detail the long record of the various researches made regarding all the menstruum which have been tried. The long list of such researches has demonstrated that the activity of sulfonamides is retarded because absorption is slowed when an oily base is used. Locatelli and Bowden[27] found, among other things, that a glycerine preparation of sulfanilamide increased its activity. These observers also contributed the observation that the glycerine must be kept completely free from water when in combination with the sulfonamides.

TOPICAL USE OF SULFONAMIDE DRUGS IN EAR CONDITIONS.

Moller[28] used a compound called in Danish literature "streptamid" for local application in acute scarlatinal purulent otitis media. This was an 0.8 per cent solution of the sulfonamide. He reports favorable results. Livingstone[29] put sulfa drugs in crystalline form into the wound cavity of mastoidectomies, using up to 4 gm., and closing the wound cavity immediately.

Bryant[30] applied sulfa powder to the ears of 16 patients with chronically discharging ears and reported excellent effects. There are favorable results also reported by Guerry and Putney[31] from topical applications.

An interesting observations on the penetration of fluids carrying sulfanilamides or even other antibacterial agents when applied to a perforated membrana tympani by way of the external auditory canal needs notation. Shapiro,[32] studying the question of spreading infection from the middle ear to the mastoidal cells by the use of ear douches, found that even when the entire membrana tympani was completely removed, only a negligible amount of penetration of the fluid from the douches reaches the cells lying adjacent to the tympanic cavity. Years ago I made similar experiments and can substantiate Shapiro's observations.

It is, therefore, also probable that the simple dusting of the middle ear spaces, either through a perforated membrana

tympani or during a recurrence of discharge after radical mastoidectomy will hardly bring the sulfonamide to the actively infected area.

There are two pathologic factors to be noted, regarding locally applied therapeutics: *1.* In acute cases the infections and breakdown of the mastoidal cells is not caused by a bacterial infection traveling by contiguity from the middle ear spaces to the mastoidal cells, and, therefore, the areas reachable by a sulfonamide in the tympanic cavity do not reach the factors concerned with involvement and coalescence of pneumatized mastoidal cells. *2.* In chronically discharging ears, there are different types of tissues involved in different cases, and there is not one type of lesion present in all cases; therefore, the topical application of a sulfanilamide does not provide the answer to the indications for therapy in all cases. None of the researches on sulfonamide therapy has produced any evidence that the sulfa compounds abate bone necrosis, polypoid formations or stop the development of pseudo-cholesteatomata,—all factors which may be present in a chronically discharging ear.

Finally, the administration of the sulfa drug in pure substance to wound cavities and surfaces is by far the most aggressive therapy which was found irritating tissues and cells, often impairing the normal regenerative functions in not a few instances.

Since the action of the sulfonamides is prevalently bacteriostatic and not bactericidal or antiseptic, the value of large concentrations locally applied has never been convincingly demonstrated.

TISSUE REACTION TO SULFONAMIDES.

Numbers of clinical observers found that sulfa drugs are not inert to tissues. An evaluation of the casuistic and experimental studies leads to the conclusion that local application of strong concentrations neither increases the safety of the procedures nor enhances the therapeutic effect. On the contrary, it may cause damage in disturbing, hampering or retarding regenerative tendencies of the tissues.

When the sulfanilamide is combined with urea, there is noted a favorable therapeutic effect. The effect of such a compound, of two or more active ingredients of a prepara-

tion, is more difficult to explain. Often their combined effect cannot be predicted *á priori*. Thus while the bacteriostatic efficiency of the sulfonamides are fairly well proven, the same cannot be stated for urea. Observers agree that the great advantage offered by urea is its specific activity as a peptonizing agent. It possesses a remarkable solvent action on necrotic tissue and pus. It is inert on living tissue, on cells and unregenerative growth, even when applied in high concentrations.

Both urea and sulfa drugs assist each other in an ideal way, though possessing quite different mechanisms of action.

In conclusion, it may be stated that urea and sulfonamides assist each other ideally in the treatment of chronic and slow healing wounds and infections. Urea increases the solubility of the sulfa drugs, and in the living, inhibits action of substances originating from the decay of bacteria and necrosis of infected tissues.

Both urea and sulfonamides arrest growth of the commonly found bacteria in wound infections, assist in the reparative tendencies of diseased areas, deodorize foul smelling wounds and aid in sloughing off dead tissue.

The determination of the optimal concentrations and proportions of combinations of urea and sulfonamides, and also the selection of menstruum and vehicles, needs more study. At the present stage of our knowledge, a preliminary deduction is all that may be made. This preliminary conclusion is based upon experiments in vitro tests with bacteria, upon experimental tests upon laboratory animals with infections, and upon a summary of clinical evaluations. As a preliminary conclusion it appears that 10 per cent urea and 5 per cent sulfathiazole present a favorable combination for use as topically applied therapy.

Sulfathiazole is preferred because this sulfa derivative is considered fairly resistant to inhibitors, it is slowly absorbed from surfaces to which it is applied, thus balancing its relatively high toxicity by its slow rate and degree of absorption from the surface to which it is applied.

The menstruum in which the urea and sulfa drug is used should be harmless in itself and should in no way inhibit the bacteriostatic action of the sulfa drug.

THE CLINICAL APPLICATION OF UREA AND SULFONAMIDE IN EAR CONDITIONS.

I applied a mixture of urea and sulfonamide (otosmosan) to various ear conditions. I applied it upon the following types of cases:

1: Cases of long standing purulent ear discharge. This group consisted of 21 individual cases. Of these, five had chronic middle ear purulency in both ears. Most had histories of middle ear discharge for many years. They also presented intervals when the ears were dry. They all came under observation recently, and to all these there was administered topical applications of otosmosan (urea and sulfathiazole).

The results were as follows: Four cases did not return for re-examination, so the result may be considered as not determined. Six did not produce a dry ear, the treatment lasting from 17 days to nine months' application. The remainder returned for subsequent examination, and were dry at the time of re-examination. The duration of treatment to procure a dry ear ranged from one case in which a bilateral chronic middle ear purulency was dry in a week; others were dry after a month's treatment, the longest time necessary to procure a dry ear in another case was five months.

Seven cases complained of local pain when applying the drug.

2: One case wherein a fenestration had been performed to improve hearing acuity returned for treatment because the excavated mastoid wound cavity was suppurating. The operation for fenestration had been done some time previously and the patient evidently had been discharged from clinical observation because the wound cavity was completely covered with epithelium at the time of discharge. There were found eroded and granulating areas in the excavated mastoid cavity. Result was good. The suppuration abated in one month, and the patient was discharged healed.

3: Four cases upon whom simple mastoidectomies had been performed many years previously. These presented middle ears which had continued to discharge since the time of operation. One case whose ear had been discharging for 20 years was much improved after treatment which lasted one month. The second, whose discharge had lasted 12 years,

was dry in one month and 10 days. The third case had a discharge since simple mastoidectomy three years previously; took three weeks to present a dry ear. The fourth case, operated some years ago, began to have an ear discharge during the month before coming under observation. In one month this ear was again dry.

4: The following cases consist of patients with persisting discharge following acute suppurative otitis media. No mastoid surgery had been performed on these. This group consists of 11 cases.

Case No.	Duration of Discharge Before Treatment	Time Under Treatment	Did Not Return for Recheck	Had Pain Sensation
I	4 months	1 week		
II	4 weeks	5 days		
III	3 weeks		Did not return	Local pain
IV	3 days	1 week		
V	2 weeks		Did not return	Local pain
VI	3 days	1 month		Local pain
VII	5 days		Did not return	Local pain
VIII	A few days		Did not return	
IX	1 month		Did not return	
X	1 week	1 month		
XI	Irregularly on and off	1 week		Local pain

5: Cases upon which radical mastoidectomies had been performed, and which presented cavities which were secondarily infected and present discharging ears. The following table gives the details of the time since radical mastoidectomies had been performed and the years which the patients alleged that the ears continued to discharge postoperatively. There were 16 such cases.

Case No.	Duration of Discharge Before Treatment	Time Under Treatment, Until Ear Was Reported Dry	Did Not Return for Recheck	No. of Cases Improved, Not Dry
I	10 years	14 days		
II	11 years	7 days		
III	5 years		Did not return	
IV	8 years			Improved—not dry
V	19 years	1 month		
VI	7 years		Did not return	
VII	13 years	1 week		
VIII	3 years		Did not return	
IX	6 months			Improved—not dry
X	11 years	2 months		
XI	6 months		Did not return	
XII	7 years			Improved—not dry
XIII	1 month	5 months		
XIV	20 years	4 days		
XV	9 years	1 week		
XVI	2 years	1 month		

THE PAIN SENSATION IN USING THE DRUG.

Numbers of patients to whom the drug was given reported varying degrees of painful sensations in the ear after using the sulfa and urea combination.

In the cases studied at the start of this investigation, some reported such painful sensations. In these the admixture of water to the product when put into the external canal may have been the factor which caused this unfavorable reaction. Cases later submitted to this therapy, where careful instruction was given to avoid any contact between the drug and water, give painful reactions only very rarely. In a few cases, the skin of the external canal showed irritation reactions, which needed local therapy and soon healed.

Regarding the production of painful reactions, it must be remembered that with chemotherapy the structural particularities of chemical substances produce vastly different and sometimes unpredictable effects on the tissues. Arey[33] tried to explain the causation of pain as due to local acidity. Gaza and Brandi,[34] whose studies were confirmed by Habler,[35] demonstrated that the topical acidity, its pH range accounted for the local pain reactions.

OBSERVATIONS ON THE OTITIC LESIONS.

The sulfonamide and urea mixture termed by its manufacturer, "Otosmosan," was applied by being instilled into the affected ear, and while the patient was lying upon the opposite side with the diseased ear up to hold the solution; the drug was kept *in situ* for about 15 minutes, and then allowed to flow out. No drying was done. This was repeated in 12 hours for the time shown in the above clinical notations on the cases tested.

It was apparent even upon the otoscopic examinations after a few days' application that a very distinct effect was produced upon the otoscopic picture. In those persistently discharging ears, there was evident a deodorizing effect.

Detritis from desquamation of skin in patients on whom radical mastoidectomies had been performed, and in which secondary saprophytic infections had been the factor which caused the persistent postoperative aural discharge, seemed to be cleansed. The discharge gradually disappears and raw

areas denuded of epithelial coverings become clean looking, and eventually covered again with epithelium.

In cases wherein simple mastoidectomies had been performed, but where the middle ear had not ceased presenting a persistent purulent otorrhea, these definitely demonstrated a cessation of the discharge for varying periods. Where these patients underwent intercurrent attacks of acute coryza, or had attacks of the so-called "grippe," during which the middle ear lesion again became activated and produced a middle ear discharge, the treatment at first lessened it, and then produced a dry ear.

It is not contended that the stoppage of the ear discharge cured the basic lesions producing the persistent otorrhea. It could not and does not cure bone necrosis, nor can it be held to stop the encroachment of squamous epithelium into the deeper cavities adjacent to the tympanic cavity termed pseudo-cholesteatome; but it has a beneficial action in serving as a solvent of the detritis and desquamated tissue, covering the matrix of the cholesteatome. It relieves the pressure symptoms from the cholesteatomatous mass, by lessening its bulk. Under this therapy, it becomes possible to carry such a case under the otologist's observation longer under conservative therapy by lessening the pressing indications for radical mastoid surgery. It does not appear to affect exuberant granulations in the middle ear in scarlatinal otitis. Thus aural polyps remain unaffected.

In my experience there seems but few contra-indications to its employment.

1. An idiosyncrasy to the sulfa drugs by the patient.

2. The presence of intracranial complications in the symptoms presented by the patient.

This combination of sulfathiazole 9.68 per cent and urea 10.82 per cent, together with 1 per cent benzocaine in absolute glycerine as a vehicle, is a valuable addition to the therapy of otitic secondary infections, being particularly valuable in the otitic chronicities.

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71 East 80th Street.

ABSCESSES OF THE PYRIFIORM SINUS.*

ANTHONY NIGRO, M.D.,
New York, N. Y.

The pyriform sinus lies between the wing of the thyroid cartilage externally and the aryepiglottic fold of the larynx internally, so that any abscess originating in this area will not ordinarily encroach to any great degree on the airway, at least not in its early stages. The path of least resistance in these cases is toward the open space posteriorly, thus tending to spontaneous rupture. With a laminograph of the larynx we are able to see the extent and location of any laryngeal involvement. The lateral X-ray views of the neck failed to show the exact involvement in the larynx, but with the use of the laminograph we could see any obliteration of the pyriform, whether due to infection or neoplasm.

Terms used to describe this condition were many, such as: *1.* Edema of larynx; *2.* perichondritis of larynx; *3.* abscess of larynx, etc.

My cases do not include abscesses elsewhere in the larynx, such as abscesses of epiglottis, ventricles, etc.

I. Frequency: According to Kernan and Shugtt, in a paper written in 1934, abscess of the larynx is an uncommon and dangerous disease. This condition formerly occurred more frequently as a complication of typhoid fever, but has become less frequent. The writers reported eight cases. Mayer, in 1931, found 18 cases occurring in a period of 18 years among 73,000 patients examined. To date there are 14 cases since 1934.

II. Age: All were adults over 25 years of age, except one, a child of five.

III. Sex: Eight males, six females.

IV. Etiology: 1. Trauma: One case, male, about 50, a painter, fell while working, striking the larynx. He began

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to complain of dysphagia soon after the accident, with some contusion of the anterior neck over the thyroid cartilage. He was taken to the hospital for observation. Dysphagia increased in severity the following week, with slight respiratory embarrassment. X-rays were negative for fracture; there was slight temperature with moderate increase in blood count. I saw the patient, in consultation, seven days after the accident. He began to show some improvement that morning.

Clinically, patient showed a fullness in the right pyriform sinus with nipple exuding pus. The abscess had probably ruptured spontaneously that morning, thus explaining the improvement in his dysphagia. There was moderate edema of arytenoids more marked on the right. Patient made an uneventful recovery.

2. Neoplasm as Cause: No abscess of the pyriform sinus as result of breakdown of neoplasm was seen.

3. Typhoid was formerly observed to be the most common disease causing this infection. None of these cases had any history of typhoid.

I believe that an abscess of the larynx almost always occurs secondary to infection elsewhere, as tonsillitis, pharyngitis, sinusitis — by direct continuity or by blood stream. The lymphatic route is least likely since the lymphatics draining the tonsils are not directly connected with those draining the peri- and parapharyngeal tissues.

V. Symptoms: 1. Pain increased in the act of swallowing. Sometimes it is difficult to swallow fluid. This symptom was very marked in the case of a child, five years of age. Here we had to resort to other methods of feeding.

2. Hoarseness in various degrees.

3. Dyspnea often the most dangerous symptom. The degree of involvement and the appearance of the larynx depends upon the severity of the infection, the size of the abscess and the location.

In my experience pain predominated in those cases which had marked edema of the arytenoid and epiglottis and some fullness of pyriform sinus. Those which showed fullness of the ventricles and in which the vocal cords were not visual-

ized, dyspnea was more pronounced together with pain. If there is abscess formation, spontaneous rupture usually occurs. In this series, 11 ruptured spontaneously into the pyriform sinus. The other two, one a child of five, and the other an old woman, did not go to abscess formation. The child died of toxemia without surgical intervention. Loré, Manning and myself attempted surgical intervention to find an abscess on the adult but we failed to find one, and the patient also died from toxemia. One required external drainage.

Three had diabetes. It is wise, in these cases, to take a blood sugar test to see if there is hyperglycemia, even though the urine is negative for sugar.

The temperature was not high in my cases except for a rise in temperature before death.

I was unable to draw any conclusion from the other laboratory findings.

VI. Complications: Two cases of which I spoke terminated fatally — no abscess formation, even though clinically there appeared to be an abscess. Death was attributed to toxemia and bronchopneumonia. No asphyxiation. Eleven formed pus and spontaneous rupture resulted with complete recovery except for some temporary interference with the movement of the cords. One case required external drainage; but the arytenoids remained edematous for two to three months afterwards. An abscess in the larynx, however, may spread to all surrounding structures. The most dangerous and the most difficult to treat is an involvement of the cricoid.

VII. Treatment: All cases were of the acute type. Eleven were hospitalized because: *1.* they were seen early; *2.* were acutely ill; *3.* showed signs and symptoms that necessitated hospitalization. In all 11 the abscess seemed to point in the pyriform sinus. A tracheotomy set was always on hand. Constant nursing care was given. Local treatments instituted were: steam, ice collar, irrigations, spray consisting of adrenalin, tannin, glycrrhiza, etc. General supportive treatment. Chemotherapy was used in two cases. One case of abscess in the pyriform sinus was treated at home, because the symptoms were not severe and the patient was progressing favorably. One case required external drainage.

VIII. Summary: Abscess of the larynx was supposed to be a rare condition according to Kernan and others. It was a common complication of typhoid fever and our present knowledge of diagnosis and treatment of abscess of the larynx is largely based on the experience obtained by men during the typhoid epidemics.

My experience has been somewhat different. Fourteen cases were seen since 1934. I do not think that this condition is rare. *Is* it because these cases are not recognized by the general practitioner? Many of these patients recovered in spite of the wrong diagnosis; however, with the sulfonamides and pencillin we believe that there will be fewer laryngeal infections.

Abscess of the larynx is usually secondary to grippe, tonsillitis, pharyngitis, sinusitis or any disease with upper respiratory manifestations.

The traumatic form is the only type that originates in the larynx itself. An abscess may form secondary to a growth in the larynx.

The most common symptoms are:

1. Pain in various degrees on swallowing, or on pressure, with or without external swelling.

2. Hoarseness in various degrees.

3. Dyspnea in various degrees.

4. The *cricoid* is seldom involved.

5. Spontaneous rupture occurred in 10 of my cases with complete recovery of the function of the larynx.

6. The *degree of discomfort* has depended upon the size of the abscess and the structures adjacent which were involved.

7. In the two who died, there was no abscess; both died from toxemia.

8. It is the first case of laryngeal abscess in a child that I have seen.

9. I believe that an abscess in the pyriform sinus should be called a lateral laryngeal abscess, just as we call an abscess in the pharynx, retro- or lateral pharyngeal.

Case 1: M. M., age 42, male. Admitted to hospital, April 21, 1933; discharged May 1, 1933.

Chief Complaints: Sore throat since April 17, 1933. Difficulty in swallowing and respiration.

Clinical Findings: Fullness of right pyriform fossa. Edema of right arytenoid and right vocal cord. Fullness of right lateral pharyngeal wall and right pyriform fossa.

This case had a spontaneous rupture both in the pyriform fossa and the lateral pharyngeal wall.

Improved.

Case 2: A. E., female. Admitted Oct. 25, 1934; discharged Oct. 29, 1934.

Chief Complaints: Dysphagia. Difficulty in respiration. Nose and throat negative.

Clinical Findings: Marked edema and swelling of both arytenoid (right more). Edema of epiglottis.

Case 3: L. O., adult, female. Office patient; seen by me on Dec. 15, 1934.

Diagnosis: Abscess in pyriform sinus which had ruptured spontaneously.

Case 4: L. A., age 37, female. Admitted to hospital, Feb. 29, 1934; discharged March 6, 1934.

Chief Camplaints: Painful swallowing for two days. Hoarseness and difficulty in breathing.

Clinical Findings: Edema of the left cord. Marked edema of left arytenoid. Swelling of left pyriform sinus.

Case 5: E. O., age 29, female. Admitted to hospital, May 18, 1936; discharged May 25, 1936.

Chief Complaint: Dysphagia, one week.

Clinical Findings: Fullness of posterior commissure and right pyriform sinus. Edema of epiglottis.

Case 6: J. P., age 45, male. Admitted to hospital, Feb. 9, 1937; discharged, Feb. 14, 1937.

Chief Complaints: Sore throat for five days before admission. Dysphagia. Slight hoarseness.

Clinical Findings: Cervical swelling, both sides. Edema of epiglottis. Fullness of pyriform sinus.

Case 7: C. A., age 60. Admitted, Feb. 25, 1937; discharged, March 12, 1937.

Chief Complaints: Previous history of sinusitis and tonsillitis. Dysphagia.

Clinical Findings: Some swelling of neck. Edema of lateral pharyngeal wall and fulness of left pyriform sinus. Slight edema of left arytenoid.

Case 8: A. P., age 69, female. Seen at home.

Chief Complaints: History of diabetes. Sore throat and dysphagia.

Clinical Findings: Edema of epiglottis. Fullness of right pyriform sinus with edema of arytenoid.

Case 9: L. L., age 54, male. Admitted to hospital, April 1, 1939; discharged, April 7, 1939. Diabetic.

Chief Complaint: Sore throat for several days. Dysphagia, Slight swelling of neck.

Clinical Findings: Edema of epiglottis. Fullness of left pyriform sinus. Slight edema of both aryenoids.

Case 10: T. V., age 47, male. Admitted to hospital, Dec. 7, 1939; discharged, Dec. 14, 1939.

Chief Complaints: Dysphagia. Marked difficulty in respiration.

Clinical Findings: Swelling of left side of neck. Marked edema of epiglottis and both arytenoids. Fullness of both pyriform sinus, more on left.

Case 11: J. S., age 5½, male. Admitted to hospital, Oct. 3, 1940, and died Oct. 6, 1940.

Chief Complaints: Dysphagia. Sense of choking only when the child was disturbed; such as drinking, irrigation or spraying of throat. No history of foreign body.

Clinical Findings: Ear, nose and throat negative. Larynx, some thickening and edema of the pharyngeal side of the epiglottis; redness and some swelling of right arytenoid and right ventricle with fullness of the right sinus. Profuse mucoid discharge between vocal cord and posterior commissure. No sternae swelling in neck.

A clinical diagnosis of a laryngeal abscess was made and was treated as such. X-rays of esophagus, neck and chest were negative both for foreign bodies and infection. Dr. Langman was called in for consultation. The child seemed to be holding his own for two days, but his condition became acute on the morning of Oct. 6, 1940. He was cyanotic, respirations were slow and shallow but not obstructive; comatosed and temperature rose to 106°. Patient was taken to the operating room for bronchoscopy or possible tracheotomy in case obstruction was found. The child stopped breathing as soon as the bronchoscope was introduced. Tracheotomy was not done. Bronchoscope entered the trachea with ease. Artificial respiration was resorted to with bronchoscope in place but all efforts failed.

Larynx, bronchial tree and esophagus were examined. There was some mucopurulent discharge between the vocal cords and pyriform sinus. No swelling or edema or foreign body was seen in the esophagus.

CHARLES TERRELL PORTER, M.D.

IN MEMORIAM

CHARLES TERRELL PORTER, M.D.,*

1889-1945.

Last Thursday we were shocked by the sudden death of Dr. Charles T. Porter. Perhaps a few of us knew that his health had not been good for the past six years. One week ago today he was here at the infirmary. He was going to do a tonsillectomy, but his color was so bad that he was persuaded to let Dr. Evans operate for him.

I saw him in the surgeons' room. He had just phoned his physician and made arrangements to enter a hospital. He was worried about his service, and I assured him that his first duty was to take care of himself and that we would take care of his hospital work.

The next morning he was much better, but the end came suddenly.

I cannot speak of Dr. Porter without making it very personal. Dr. Porter was the first Boston physician that I met when I came to New England. He was my consultant at the U. S. Public Health Service, Hospital No. 36. It was he who introduced me at the infirmary and to Dr. Mosher.

The infirmary has lost one of its strongest supporters and I have lost a very close friend.

L. A. SCHALL.

*Presented at the weekly Clinical Staff Meeting, April 25, 1945.

CHARLES TERRELL PORTER, M.D.†

Dr. Porter died suddenly in Boston, April 19, 1945, of coronary thrombosis. He was 56 years old.

He was born in Alabama and was graduated from the Alabama Polytechnic Institute in 1908 as an engineer. He received his medical degree from the University of Virginia in 1912. During World War I he served with the Harvard Hospital Unit in France with the British Army. He was a senior surgeon at the Massachusetts Eye and Ear Infirmary, and Lecturer in Otology at the Harvard Medical School. He maintained offices in Boston and Waltham. He had a summer residence at Rockport, Mass.

He married the niece of Dr. Alfred Worcester, of Waltham, Mass. Dr. Porter had one child, a daughter who lately graduated from Radcliffe, majoring there in art, for which she has much talent. A few months ago she was married to an officer in the Navy, in Piety Corner Chapel, Waltham, the same church from which her father was buried last Saturday.

Dr. Porter was connected by marriage with the Canadian Minister of Transportation and it was he who made luxurious salmon fishing trips possible to Dr. Porter. One could not help envying him these excursions.

He had the gallantry and the quick sense of honor characteristic of the Southerner. He was an accomplished sportsman, his favorite sports being hunting, fishing and golf. He made annual trips north and south, making these a let-up from medicine. Many of us have shared his bounty after successful trips.

How he happened to lose his Southern accent I never knew. I wish he hadn't, because its softness is a relief in these parts.

He had a hobby of collecting superlative examples of guns and pistols. He was interested in them not for their value as antiques but for their workmanship. He would have been

†Read at the weekly Clinical Staff Meeting of the Department of Otolaryngology, Massachusetts Eye and Ear Infirmary, April 25, 1945.

a poor man to meet in a duel. He was a judge of thoroughbred dogs. He was a lively host, and a man's man.

In medical discussions he was forthright, short and to the point. His opinions were backed by a rich experience. He was a formidable opponent in debate. I was always relieved when he agreed with me, and he did this quite often, I am glad to say.

When he was on service, or for that matter when he was merely in town, I felt more secure about hospital affairs.

He had an unusual training. He graduated from the Alabama School of Technology as an engineer. Then he switched to medicine; why, I never knew. He took this degree in medicine at the University of Virginia, the most consistently beautiful university in America. His special medical education was obtained first as house officer on the eye side of this infirmary, and then he went up higher and took the house officership on the ear, nose and throat side. With all this background he escaped falling into the pettiness which can go with a specialty.

He did little research work, which at the moment seemingly is the only academic yardstick of a professional man. Thus he escaped being one-sided. He did not go off on tangents. Up-to-date knowledge, full operative skill, solidity and dependability were his characteristics.

He held high positions in the various special societies. Recently he was Vice-President of the American Otological Society, and did valiant service on the Council. At one time he was Chairman of the Eastern Section of the American Laryngological, Rhinological Society, Inc., and at his death was President-elect.

Dr. Porter was consultant in an unusually large number of Boston and near-by hospitals, which shows how greatly his knowledge, experience and judgment were sought after and appreciated.

He was one of the strong men of the staff of the infirmary.

H. P. MOSHER.

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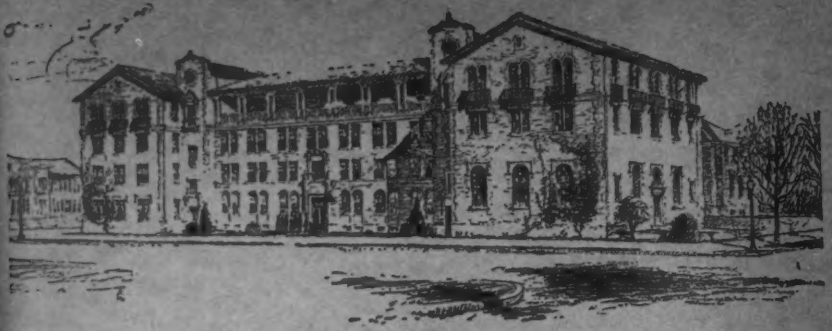

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